

REMARKS

Applicants thank the Examiner for the thorough consideration given the present application, Claims 1, 7, 9 and 10 are currently being prosecuted. The Examiner is respectfully requested to reconsider his rejections in view of the Amendments and Remarks as set forth hereinbelow.

CLAIM FOR PRIORITY

It is gratefully acknowledged that the Examiner has recognized the Applicants' claim for foreign priority. Because the Applicants' claim for foreign priority has been perfected, no additional action is required from the Applicants at this time.

DRAWINGS

It is gratefully acknowledged that the Examiner has approved the Formal Drawings submitted by the Applicants. The drawings comply with the requirements of the U.S.P.T.O. No further action is necessary.

ACKNOWLEDGMENT OF INFORMATION DISCLOSURE STATEMENT

The Examiner has acknowledged the previously filed Information Disclosure Statement. An initial copy of the PTO-1449 has been received from the Examiner. No further action is necessary at this time.

REJECTION UNDER 35 U.S.C. § 102

Claim 1 stands rejected under 35 U.S.C. § 102(b) as anticipated by Hirabayashi. This rejection is respectfully traversed.

Amended independent claim 1 includes a combination of features and is directed to a method of driving an electromagnetic pump. The method includes conveying a fluid from a pump chamber formed inside a cylinder by housing a plunger including a permanent magnet

inside the cylinder, passing a current through an aircore electromagnetic coil fitted around the cylinder to reciprocally move the plunger in the axial direction inside the cylinder, and alternately applying a pulse voltage on a positive side and a negative side to drive the electromagnetic coil such that a change in voltage that occurs when the polarity of the pulse voltage is inverted has a linearly or exponentially continuous slope at least between the positive side and the negative side.

These features are supported at least by the non-limiting examples shown in FIGS. 1 and 2 and described in the corresponding description in the specification. For example, FIG. 1 illustrates that when the polarity of the pulse voltage is inverted it has a linearly continuous slope at least between the positive side and the negative side. FIG. 2 illustrates that when the polarity of the pulse voltage is inverted it has an exponentially continuous slope at least between the positive side and the negative side.

On the contrary, Hirabayashi discloses an electromagnetic pump in which a plunger is reciprocally moved by an AC voltage supplied from an AC power source. However, Hirabayashi does not teach or suggest forms of a pulse voltage and a pulse current, which are controlled and input to an electromagnetic coil.

Accordingly, it is respectfully submitted independent claim 1 and each of the claims depending therefrom are allowable.

REJECTION UNDER 35 U.S.C. § 103(a)

Claims 2 and 3 stand rejected under 35 U.S.C. § 103(a) as unpatentable over Hirabayashi. This rejection is respectfully traversed.

Claims 2 and 3 are dependent claims. Accordingly, it is respectfully submitted these claims are also allowable as Hirabayashi does not teach or suggest the features recited in independent claim 1 as discussed above.

Claims 4-6 stand rejected under 35 U.S.C § 103(a) as unpatentable over Hirabayashi in view of Hitoo et al. This rejection is respectfully traversed.

Amended independent claim 4 includes similar features as discussed above with respect to claim 1. As discussed above, Hirabayashi does not teach or suggest forms of a pulse voltage and a pulse current being controlled and input to an electromagnetic coil. Further, Hitoo et al. is related to a technology of maintaining a constant stroke of a piston even if a load is varied. However, Hitoo et al. also does not teach or suggest the claimed linearly or exponentially continuous slope.

Accordingly, it is respectfully submitted independent claim 4 and each of the claims depending therefrom are also allowable.

Claims 7-10 stand rejected under 35 U.S.C. § 103(a) as unpatentable over Hirabayashi in view of Kurahashi et al. This rejection is respectfully traversed.

Amended independent claim 7 includes a combination of features and is directed to a method of driving an electromagnetic pump. The method includes conveying a fluid from a pump chamber formed inside a cylinder by housing a plunger including a permanent magnet inside the cylinder, passing a current through an aircore electromagnetic coil fitted around the cylinder to reciprocally move the plunger in the axial direction inside the cylinder, and applying a pulse voltage or flowing a pulse current including a period where a voltage or current value is

zero when the polarity of a driving voltage or a supplied current of the electromagnetic coil is inverted. Further, claim 7 has been amended to clarify that the pulse voltage or the pulse current flows so that a minute voltage pulse of at least 30% of a maximum voltage is applied or a minute current pulse at least 30% of a maximum current flows before the period where the voltage or current value is zero.

Independent claim 9 include similar features in a varying scope. These features are supported at least by FIGS. 7 and 8 and the corresponding description in the specification.

As discussed above, Hirabayashi does not teach or suggest forms of a pulse voltage and a pulse current being controlled and input to an electromagnetic coil. Further, Kurahashi et al. illustrates in FIG. 10 there are periods, in each of which an input current changes to zero when a moving direction of a piston is changed, and a minute pulse voltage is input as an input voltage. However, the minute pulse voltage is not willfully input and is a “counter electric voltage,” which is generated, as minute pulses, by induced voltage generated when a current direction of the coil is changed.

On the contrary, in the present invention, when the current direction is changed near the stroke end of the plunger, the zero-voltage or the zero-current period and the minute pulse current or voltage are combined, so that the driving method of the present invention is different from Hirabayashi.

Accordingly, it is respectfully submitted independent claims 7 and 9 and each of the claims depending therefrom are also allowable.

ABSTRACT AND SPECIFICATION CHANGES

Further, a new abstract has been added in light of the comments noted in the Office Action. The specification has also been amended to include the proper headings. No new matter has been added.

CONCLUSION

In view of the above remarks, it is believed that the claims clearly distinguish over the patents relied upon by the Examiner, either alone or in combination.

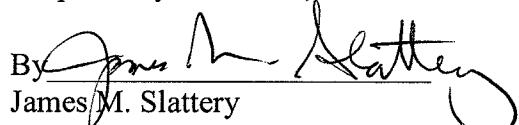
Since the remaining patents cited by the Examiner have not been utilized to reject the claims, but to merely show the state of the art, no comment need be made with respect thereto.

If the Examiner believes for any reason, that personal communication will expedite prosecution of this application, the Examiner is invited to telephone David A. Bilodeau at (703) 205-8072 in the Washington, D.C. area.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37.C.F.R. §§1.16 or 1.147; particularly, extension of time fees.

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Respectfully submitted,

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